International Journal of Biomedicine 12(2) (2022) 269-272
http://dx.doi.org/10.21103/Article12(2)_OA12

ORIGINAL ARTICLE

Dermatology

INTERNATIONAL JOURNAL OF BIOMEDICINE

Erbium YAG Laser in the Treatment of Androgenetic Alopecia

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Abstract

The article presents data on the effectiveness of the 2940 nm wavelength erbium-doped yttrium aluminum garnet laser (Er:YAG) in the treatment of androgenetic alopecia (AA) in 85 men. All AA patients underwent a video trichodermatoscopy examination of the scalp using an Aramo-SG video camera (Korea) with ×60 and ×200 lenses, and the Trichoscience diagnostic program. The results of the study were evaluated by videotrichodermatoscopy by the presence of atrophied HF before and after 3 months of laser therapy. A 3-month erbium laser treatment using a 2940-nm Er:YAG laser along with the conventional therapy showed a high efficiency, which was expressed in a decrease in microfibrosis around the hair follicles and an increase in hair growth in the anagen stage. (**International Journal of Biomedicine. 2022;12(2):269-272.**)

Key Words: androgenetic alopecia • erbium laser • microfibrosis • trichoscopy

For citation: Azimova FV, Zakirov RR, Nurmatova IB. Erbium YAG Laser in the Treatment of Androgenetic Alopecia. International Journal of Biomedicine. 2022;12(2):269-272. doi:10.21103/Article12(2)_OA12

Abbreviations

AA, androgenetic alopecia; **EL**, erbium laser; **HF**, hair follicles.

Introduction

One of the most common causes of hair loss is androgenetic alopecia (AA), which dramatically reduces the quality of life, since the awkward appearance can lead to psychological maladaptation. According to some authors, up to 70% of men and 40% of women experience AA. AA is a progressive baldness caused by the action of androgens on the hair follicles.[1,2] The main reason for the development of AA is the activation of the androgen receptor, resulting in a shortening of the anagen, or growth phase, in the normal hair-growth cycle. Circulating free testosterone either binds to intracellular androgen receptors in the hair bulb and dermal papilla[3-5] or is metabolized to dihydrotestosterone by the enzyme 5-α-reductase.[6]

In recent years, lasers and various light sources have been widely used in medicine, in particular in dermatocosmetology. It is well known that Low Level Laser Therapy and the 1550 nm Erbium Glass Fractional Laser are highly effective in treating all forms of hair loss by stimulating hair follicles. But today, we also have the 2940 nm wavelength erbium-doped yttrium aluminum garnet (Er:YAG) laser, which is able to penetrate into the dermis to a depth of 3-4 mm, and energy absorption occurs in the area of the dermal papilla, resulting in an increase in blood circulation of the papilla and activation of metabolism in the hair follicle.[7-9]

Effects of using the 2940 nm wavelength Er:YAG in AA:[10-12]

- ✓ Activation of mitosis, proliferation in the cells of the hair follicles, which leads to a lengthening of the anagen phase and the growth of new hair.
- ✓ Resorption of microfibrosis of hair follicles (HF) because EL generates radiation in the form of microfractional "columns" that penetrate the dermis and cause tissue heating, which leads to a powerful anti-inflammatory effect and a decrease in fibrosis of the scalp skin. The epidermis receives minimal damage, which disappears after a few days and which is one of the indisputable

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advantages of this method in the treatment of AA.

- ✓ Anti-inflammatory effect (reducing the infiltration of HF by lymphocytes). Also, one of the likely mechanisms of action of erbium laser (EL) is the stimulation of apoptosis of T-lymphocytes.
- ✓ Activation of signaling pathways (Wnt, BMP, Shh, and FGF). β-catenin can induce the transition of the hair-growth cycle from the telogen phase to the anagen phase. It has also been reported that Wnt 10b can induce a telogen-to-anagen transition via canonical Wnt signaling pathways to promote hair follicle growth.[13-17]

The purpose of this study was to evaluate the effectiveness of the 2940 nm wavelength Er:YAG laser in the treatment of male AA.

Materials and Methods

We examined 105 men with AA aged 18 to 41 years. The main group consisted of 85 AA patients who received external laser therapy along with traditional therapy, including vitamin therapy, microelements, angioprotectors and specific blockers of hair follicles. The main group patients underwent laser therapy using the 2940-nm Fractional Er:YAG (Alma Harmony XL), handpieces 7×7mm, pulse energy 800-1200 mJ/cm^2, pulse mode - Long, 1-2 passes along the partings of the scalp with an interval of 3 weeks for 3 months. The comparison group consisted of 20 AA patients who received only traditional therapy. The control group consisted of 35 healthy individuals.

The distribution of patients with AA according to the duration of the pathological process was as follows: disease duration of 1 to 5 years - 51.6%, up to 1 year - 24.8%, and from 5 up to 10 years - 23.6%. The results of a hormonal test for testosterone showed an increase in its concentration in the blood in only 4% of AA patients. Provoking factors for hair loss were stressful situations (62%), chronic diseases of the nose and throat (43%), and the use of hormonal drugs (28%).

All AA patients underwent a video trichodermatoscopy examination of the scalp using an Aramo-SG video camera (Korea) with ×60 and ×200 lenses, and the Trichoscience diagnostic program. The main detail of the study was a phototrichogram, which allows one to differentiate AA from other forms of alopecia. For this study, an area of pronounced hair thinning was determined, usually in the parietal region of the scalp, and the hair was shaved with a trimmer in an area of 8x8mm. After 2 days, when among the shaved hair it was possible to detect hair that had grown by 1 mm (anagen) and the remaining hair of the same size (telogen), the areas were tinted with an ammonia-free hair dye and entered into a computer program (Trichoscience) using an ×60 lens.

The results of the study were evaluated by videotricho-dermatoscopy by the presence of atrophied HF before and after 3 months of laser therapy.

Statistical analysis was performed using the Statistica 10.0 software package (Stat-Soft Inc., USA). The mean (M) and standard error of the mean (SEM) were calculated. For data with normal distribution, inter-group comparisons were performed using Student's t-test. Differences of continuous variables departing from the normal distribution, even after transformation, were tested by the Mann-Whitney *U*-test. A probability value of $P<0.05$ was considered statistically significant.

The study protocol was approved by the Ethics Committees of the Center for the Development of Professional Qualification of Medical Workers.

Results and Discussion

According to the BAsic and SPecific (BASP) classification of alopecia, in the main group, 36(42.3%) patients had type C2-C3, in which there was hair loss in the frontal and temporal areas of the scalp; 26(30.5%) patients had type M3, in which there were pronounced bald patches in the fronto-parietal region; and 23(27.2%) patients had U1, in which the bald patches of the frontal and parietal regions merged and only the hair of the occipital region of the scalp remained intact. A characteristic feature of the phototrichogram, carried out in the parietal zone, was an increased amount of velus hair and thinning hair (more than 45%) (Fig.1).

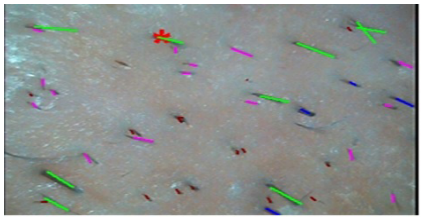

Fig. 1. *Phototrichogram: AA type C2-C3.*

Fig. 2. *Dermoscopy: oily seborrhea*

Fig. 3. *HF in the telogen stage.*

When examining the scalp under the ×200 lens, oily, sometimes dry seborrhea was more often noted; HF of the examined hair were mostly in the telogen stage (Fig. 2 and Fig. 3).

A study of the anagen and telogen phases in the main group patients showed a highly significant decrease in the number of hairs in the anagen phase and an increase in the number of hairs in the telogen stage in the parietal region, while the ratio of growth and resting phases in the occipital regions was not significant in type C2-C3 and significantly decreased in types M3 and U1. So, in AA patients with types C2-C3, M3 and U1 (Table 1), the number of hairs in the growth stage in the parietal region was 58.4±3.1%, 41.7±1.1%, and 32.1±0.8%,

respectively, while in the control group it was 87.1±4.3%. At the same time, the number of hairs in the resting stage was 41.6±1.8%, 58.3±2.4%, and 67.9±2.0% in C2-C3, M3, and U1 types, respectively.

Table 1.

The number of hair (%) in the growth and resting stages in the control group and main group

Scalp region/ hair growth cycle		Control group (n=35)	Main group: AA type		
			C2-C3 (n=36)	M3 (n=26)	U1 (n=23)
Parietal region	Anagen	87.1±4.3	58.4±3.1**	41.7±1.1**	32.1±0.8**
	Telogen	12.9±1.9	41.6±1.8**	58.3±2.4**	67.9±2.0**
Occipital region	Anagen	85.4±3.9	81.7±1.1	79.2±3.2	72.1±1.8**
	Telogen	14.6±2.3	18.3±2.4	20.8±1.4*	27.9±2.5**

** - P<0.05,** - P<0.01 - relative to the control group*

Trichoscopic criteria for atrophied HF in the form of "white" dots after EL therapy are shown in Table 2. Thus, in type C2-C3, the number of atrophied HF significantly decreased, compared to the initial level, and amounted to 11.4±2.17% versus 45.2±3.58%, with M3 type – 28.3±3.46% and 71.7±6.2%, respectively, and with U1 type – 54.8±711% and 88.6±5.91%, respectively.

Table 2.

Atrophied HF (%) in the form of «white» dots after EL therapy

AA type	Before treatment	*P*-value	After treatment
C2-C3 (n=36)	45.2±3.58	<0.001	11.4±2.17
M3 (n=26)	71.7±6.2	<0.001	28.3±3.46
U1 (n=23)	88.6±5.91	<0.001	54.8±7.11

Table 3.

The effectiveness of the therapy in the study groups with AA

Effectiveness of the therapy	Comparison group (n=20)		Main group (n=85)	
	n	%	n	%
Clinical recovery	-	-	-	-
Significant improvement	-	-	41	48.2
Improvement	7	35	27	31.8
No changes	11	55	16	18.8
Worsening	2	10	1	1.2

The effectiveness of the therapy in the study groups was evaluated on the basis of the following criteria (Table 3):

- ✓ Clinical recovery: full hair growth in the foci of hair loss
- ✓ Significant improvement: a growth of a large amount of hair (50%-70%) in the foci of hair loss
- ✓ Improvement: moderate hair growth in the foci of hair loss (25%-50%)
- ✓ No changes: lack of hair-growth dynamics
- ✓ Worsening: the appearance of new foci of hair loss and the absence of hair growth in old foci.

"Significant improvement," "Improvement," and "No changes" were found in 48%, 32%, and 19% of patients, respectively, against the background of EL therapy, and 0%, 35%, and 55%, respectively, in the control group.

Conclusion

A 3-month erbium laser treatment using a 2940-nm Er:YAG laser along with the conventional therapy showed a high efficiency, which was expressed in a decrease in microfibrosis around the hair follicles and an increase in hair growth in the anagen stage.

Competing Interests

The authors declare that they have no competing interests.

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